WHAT IS CLAIMED IS:

1. A liquid chemical composition for anaerobic biodegradation, detoxification, and transformation of toxic organic and inorganic compounds in contaminated geologic media, comprising:

a) sodium nitrate in the range of one-fifth (0.2) to four (4) pounds per gallon of said chemical composition;

b) sodium hexametaphosphate or other biologically hydrolyzable ring or linear polyphosphate in the range of one twentieth (0.05) to five (5) pounds per gallon of said chemical composition;

c) a surfactant in the range of 0.01% to 10% by volume of said chemical composition; and

d) a diluent.

2. A chemical composition in accordance with Claim 1, further including one or more of the following chelating agents selected from the group consisting of citric acid, sodium citrate, nitrilotriacetic acid (NTA), ethylenediaminetetraacetic acid (EDTA) and equivalents thereof; in the range of one twentieth (0.05) to three (3) pounds per gallon of said chemical composition.

3. A chemical composition in accordance with Claim 1, wherein the molar ratios of nitrate (NO_3^-) to phosphorus (P) are in the range of 2:1 to 50:1.

4. A chemical composition in accordance with Claim 1, further including an inert gas as a carrier for said chemical composition.

5. A chemical composition in accordance with Claim 4, wherein said inert gas is argon, neon, krypton or xenon.

6. A liquid chemical composition for anaerobic biodegradation, detoxification, and transformation of toxic organic and inorganic compounds in contaminated geologic media, comprising:

a) sodium nitrate in the range of zero (0) to four (4) pounds per gallon of said chemical composition;

b) nitrous oxide in the range of one one hundredth (0.01) to one fiftieth (0.02) pounds per gallon of said chemical composition;

c) sodium hexametaphosphate or other biologically hydrolyzable ring or linear polyphosphate in the range of one two hundredth (0.005) to five (5) pounds per gallon of said chemical composition;

d) a surfactant in the range of 0.01% to 10% by volume of said chemical composition; and

e) a diluent.

7. A chemical composition in accordance with Claim 6, further including one or more of the following chelating agents selected from the group consisting of citric acid, sodium citrate, nitrilotriacetic acid (NTA), ethylenediaminetetraacetic acid (EDTA)

and equivalents thereof; in the range of one twentieth (0.05) to three (3) pounds per gallon of said chemical composition.

8. A chemical composition in accordance with Claim 6, wherein the molar ratios of the combined nitrous oxide and nitrate nitrogen (N) to phosphorus (P) are in the range of 0.5:1 to 50:1.

9. A chemical composition in accordance with Claim 6, further including an inert gas as a carrier for said chemical composition.

10. A chemical composition in accordance with Claim 9, wherein said inert gas is argon, neon, krypton or xenon.

11. A chemical composition in accordance with Claim 1, further including nitrous oxide (N_2O) gas as a supplemental chemical for direct infiltration into the contaminated media.

12. A liquid chemical composition for anaerobic biodegradation, detoxification and transformation of toxic organic and inorganic compounds in geologic media, comprising:

a) a sulfate-containing ($SO_4^=$) electron acceptor chemical compound in the form of ferrous sulfate heptahydrate, sodium sulfate or other soluble salts of sulfate in the range of one-half (0.5) to four (4.0) pounds per gallon of said chemical composition;

b) sodium hexametaphosphate or other biologically

hydrolyzable ring or linear polyphosphate in the range of one twentieth (0.05) to five (5) pounds per gallon of said chemical composition;

c) a surfactant in the range of 0.01% to 10% by volume of said chemical composition; and

d) a diluent.

13. A chemical composition in accordance with Claim 12, further including one or more of the following chelating agents selected from the group consisting of citric acid, sodium citrate, nitrilotriacetic acid (NTA), ethylenediaminetetraacetic acid (EDTA) and equivalents thereof; in the range of one twentieth (0.05) to three (3) pounds per gallon of said chemical composition.

14. A chemical composition in accordance with Claim 13, wherein the molar ratios of sulfate ($SO_4^{=}$) to phosphorus (P) are in the range of 2:1 to 50:1.

15. A chemical composition in accordance with Claim 12, further including an inert gas as a carrier for said chemical composition.

16. A chemical composition in accordance with Claim 15, wherein said inert gas is argon, neon, krypton or xenon.

17. A liquid chemical composition for anaerobic biodegradation, detoxification, and transformation of toxic organic and inorganic compounds in geologic media comprising:

a) a primary compound acting as a source of both nutrient nitrogen and two forms of electron acceptor in the form of ferric nitrate nonahydrate in the range of one-half (0.5) to four (4.0) pounds per gallon of said chemical composition.

b) a biologically usable phosphate in the form of sodium hexametaphosphate or other biologically hydrolyzable ring or linear polyphosphate in the range of one twentieth (0.05) to five (5) pounds per gallon of said chemical composition; and

c) a surfactant in the range of 0.01% to 10% by volume of said chemical composition; and

d) one or more of the following chelating agents selected from the group consisting of citric acid, sodium citrate, nitrilotriacetic acid (NTA), ethylenediaminetetraacetic acid (EDTA) and equivalents thereof in the range of one twentieth (0.05) to three (3) pounds per gallon of said chemical composition; and

e) a diluent.

18. A chemical composition in accordance with Claim 17, wherein the molar ratios of the combined nitrate and ferric iron [NO_3^- and Fe(III)] to phosphorus (P) are in the range of 2:1 to 50:1.

19. A chemical composition in accordance with Claim 17, further including an inert gas as a carrier for said chemical composition.

20. A chemical composition in accordance with Claim 19, wherein said inert gas is argon, neon, krypton or xenon.

21. A liquid chemical composition for anaerobic biodegradation, detoxification, and transformation of toxic organic and inorganic compounds in geologic media, comprising:

a) a primary compound acting as a source of electron acceptor nitrogen, nutrient nitrogen and micronutrient manganese, in the form of manganese nitrate, manganese nitrate tetrahydrate, or manganese nitrate hexahydrate in the range of one-half (0.5) to four (4.0) pounds per gallon of said chemical composition;

b) a biologically usable phosphate in the form of sodium hexametaphosphate or other biologically hydrolyzable ring or linear polyphosphate in the range of one twentieth (0.05) to five (5) pounds per gallon of said chemical composition;

c) a surfactant in the range of 0.01% to 10% by volume of said chemical composition; and

d) a diluent.

22. A chemical composition in accordance with Claim 21, further including one or more of the following chelating agents selected from the group consisting of citric acid, sodium citrate,

nitrilotriacetic acid (NTA), ethylenediaminetetraacetic acid (EDTA) and equivalents thereof; in the range of one twentieth (0.05) to three (3) pounds per gallon of said chemical composition.

23. A chemical composition in accordance with Claim 21, wherein the molar ratios of combined nitrate and manganese to phosphorus are in the range of 2:1 to 50:1.

24. A chemical composition in accordance with Claim 21 further including an inert gas as a carrier for said chemical composition.

25. A chemical composition in accordance with Claim 24, wherein said inert gas is argon, neon, krypton or xenon.

26. A liquid chemical composition for anaerobic biodegradation, detoxification, and transformation of toxic organic and inorganic compounds in contaminated geologic media comprising:

a) a chelating agent which makes transition metals, including, but not limited to Mn(IV) and Fe(III) present in the geologic media more biologically available to MRP microorganisms, with this chelating agent selected from the group which includes citric acid, sodium citrate, nitrilotriacetic acid (NTA), ethylenediaminetetraacetic acid (EDTA) and equivalents thereof; in the range of one twentieth (0.05) to three (3) pounds per gallon of said chemical composition.

b) a biologically usable phosphate in the form of sodium

hexametaphosphate or other biologically hydrolyzable ring or linear polyphosphate in the range of one twentieth (0.05) to five (5) pounds per gallon of said chemical composition;

c) a surfactant in the range of 0.01% to 10% by volume of said chemical composition; and

d) a diluent.

27. A chemical composition in accordance with Claim 26, further including an inert gas as a carrier for said chemical composition.

28. A chemical composition in accordance with Claim 27, wherein said inert gas is argon, neon, krypton or xenon.

29. Bioremediation apparatus for anaerobic biodegradation, detoxification, and transformation of toxic organic and inorganic compounds in a contaminated geologic media, comprising:

a) a first set of one or more storage tanks containing a chemical composition for anaerobic biodegradation of toxic compounds in contaminated geologic media;

b) valve means connected to said first set of storage tanks;

c) at least one logic controller means for opening and closing said valve means connected to said first set of storage tanks to supply said chemical composition to the contaminated geologic media; and

d) a screened well connected to said first set of storage tanks for supplying said chemical composition to the contaminated geologic media.

30. Bioremediation apparatus in accordance with Claim 29, wherein said one or more storage tanks contain an inert gas as a carrier for said chemical compositions.

31. Bioremediation apparatus in accordance with Claim 30, wherein said one or more storage tanks are pressurized for the pressurized storage and dispensing of said chemical composition and said inert gas.

32. Bioremediation apparatus in accordance with Claim 29, wherein said logic controller means includes means for inputting and executing an algorithm or computer program into said logic controller means.

33. Bioremediation apparatus in accordance with Claim 29, further including one or more sensors connected to said logic controller means.

34. Bioremediation apparatus in accordance with Claim 33, wherein said sensors are disposed in the contaminated geologic media for taking readings of conditions therein.

35. Bioremediation apparatus in accordance with Claim 34, wherein said sensors include means for sensing data to obtain measurements of static-water levels, the changes in static-water levels, the in-situ concentrations of each of the components of the said chemical compositions or the by products thereof, the rate of use of one or more of the components of the said chemical compositions by anaerobic microorganisms, the total estimated mass of the microorganisms in-situ, the biomass growth rate of the naturally occurring anaerobic microorganisms in-situ, the relative metabolic activity of the naturally occurring anaerobic microorganisms in-situ, the conversion rates of the converted end-products being generated by the anaerobic microorganisms, the pH and/or redox potential of the saturated geologic media or biomass, and the temperature of the saturated geologic media or biomass.

36. Bioremediation apparatus in accordance with Claim 33, further including means for transmitting the data received by said sensors to a data-logger or computer at a remote location.

37. Bioremediation apparatus in accordance with Claim 35, wherein said logic controller means further includes programming means for controlling the dispensing of said chemical compositions at predetermined dispensing rates or as a function of one or more of said measurements.

38. Bioremediation apparatus in accordance with Claim 37 further including means for remotely inputting an algorithm or computer program into the said logic controller means by the user for purposes of controlling the dispensing of the said chemical compositions.

39. Bioremediation apparatus in accordance with Claim 37, wherein said programming means includes a programmer component having a timing element for electronically opening and closing said valve means for the precise metering of said chemical composition into the contaminated geologic media.

40. Bioremediation apparatus in accordance with Claim 29, wherein said valve means includes an automatic ball valve being electronically connected to said logic controller means and a manual ball valve being mechanically connected to said logic controller means.

41. Bioremediation apparatus in accordance with Claim 29, further including:

a) a pressurized water supply line;

b) a pressure reducing valve connected to said pressurized water supply line;

c) an alternate automatic valve means connected to said pressure reducing valve;

d) an alternate logic controller means being

electronically connected to said alternate automatic valve means for opening and closing said alternate automatic valve means connected to said pressurized water supply line to supply said water supply to the contaminated geologic media;

e) an alternate manual valve means wherein said valve means is mechanically connected to said alternate logic controller means;

f) said screened well being connected to said pressurized water supply line for supplying said water supply to the contaminated geologic media.

42. Bioremediation apparatus in accordance with Claim 29, further including:

a) two or more sets of one or more storage tanks containing additional chemical compositions for anaerobic biodegradation of toxic compounds in the contaminated geologic media;

b) two or more valve means connected to said two or more sets of storage tanks;

c) one or more alternate logic controller means for opening and closing said additional valve means connected to said additional sets of storage tanks to supply said additional chemical compositions to the contaminated geologic media; and

d) said screened well being connected to said additional sets of storage tanks for supplying said alternate chemical compositions to the contaminated geologic media.

43. Bioremediation apparatus in accordance with Claim 42, wherein said logic controller means and said alternate logic controller means each include means for controlling the delivery of said chemical composition and said additional chemical compositions to the contaminated geologic media simultaneously or in an alternating manner.

44. Bioremediation apparatus in accordance with Claim 29, further including a vapor suppression system for reducing flash fire and/or explosion hazards in the contaminated geologic media, comprising:

a) one or more gas cylinder tanks containing an inert gas for reducing oxygen gas (O_2) concentrations within the contaminated geologic media;

b) control valve means connected to said one or more gas cylinder tanks;

c) pressure sensing means connected to said one or more gas cylinder tanks for providing a minimum pressure setting in which said inert gas is discharged from said gas cylinder tanks to the contaminated geologic media; and

d) means for connecting a second well to said gas cylinder tanks

for supplying said inert gas to the contaminated geologic media.

45. Bioremediation apparatus in accordance with Claim 44, wherein said inert gas is argon, neon, krypton or xenon.

46. Bioremediation apparatus in accordance with Claim 44, wherein said control valve means is a manual shut-off valve.

47. Bioremediation apparatus in accordance with Claim 44, wherein said pressure sensing means include one or more in-line pressure gauges.

48. A solid chemical composition for anaerobic biodegradation, detoxification, and transformation of toxic organic and inorganic compounds in contaminated geologic media, including one or more of the following granular Manganese (IV)-containing compositions, selected from the group consisting of glauconite, manganese greensand and pyrolusite.

49. A solid chemical composition in accordance with Claim 48 wherein the Manganese (IV) contained in said granular composition acts as an electron acceptor for manganese-reducing bacteria and/or other MRP anaerobic bacteria.

50. A solid chemical composition in accordance with Claim 49 wherein the composition is used as a component in a remediation trench, slurry-wall, semi-permeable barrier, as a well-packing material in a screened well, or other subsurface remedial application.

51. A solid chemical composition for anaerobic biodegradation, detoxification, and transformation of toxic organic and inorganic compounds in contaminated geologic media, comprised in whole or in part with minerals containing Fe (III) including Fe(III)OH and equivalents thereof.

52. A solid chemical composition in accordance with Claim 51 wherein the Fe (III) contained in said granular composition acts as an electron acceptor for iron-reducing bacteria and/or other MRP anaerobic bacteria.

53. A solid chemical composition in accordance with Claim 52 wherein the composition is used as a component in a remediation trench, slurry-wall, semi-permeable barrier, as a well-packing material in a screened well, or other subsurface remedial application.

54. A method for anaerobic biodegradation, detoxification, and transformation of toxic organic and inorganic compounds in contaminated geologic media comprising the steps of:

a) pressurizing one or more storage tanks containing a chemical composition and an inert carrier gas;

b) connecting valve means to said one or more pressurized storage tanks;

c) connecting a well to said valve means for supplying said chemical composition and said inert carrier gas through said

well to the contaminated geologic media; and

d) opening and closing said valve means to dispense said chemical composition and said inert carrier gas under pressure through said well to the contaminated geologic media.

55. A method in accordance with Claim 54, further including the step of disposing sensors in the contaminated geologic media for taking readings of conditions therein.

56. A method in accordance with Claim 55, wherein the step of opening and closing said valve means is performed by logic controller means having means for inputting and executing an algorithm or computer program into said logic controller means.

57. A method in accordance with Claim 54, wherein the step of opening and closing said valve means is performed by logic controller means having means for inputting and executing an algorithm or computer program into said logic controller means.

58. A method in accordance with Claim 57, wherein the program of said logic controller means is modified via an off-site computer means.

59. A method in accordance with Claim 56, wherein the output from one or more said sensors directly modifies or controls the program running in said logic controller means.

60. A method in accordance with Claim 59, wherein the data from said sensors is a) transmitted to an off-site computer; and

b) analyzed and interpreted by the user; and

c) used to create a new or modified algorithm or program for use in said logic controller means; and

d) input to said logic-controller means from an off-site computer.

61. A method of alternating the cycles of redox potential and/or the predominant microbial respiration pathway within the contaminated geologic media, comprising the steps of:

a) introducing one or more of said chemical compositions of Claims 1, 6, 12, 17, 21, and 26 into the contaminated geologic media for one or more specified periods of time;

b) subsequently introducing one or more of said chemical compositions of Claims 1, 6, 12, 17, 21, and 26 into the contaminated geologic media for one or more additional specified periods of time; and

c) repeating and/or alternating steps a) and b) until the levels of contaminants in the contaminated geologic media have been reduced.

62. A method of alternating the cycles of redox potential and/or the predominant respiration pathways of MRP anaerobic microorganisms within the contaminated geologic media in-situ,

comprising the steps of:

a) performing a first phase of operation by adding one or more of the chemical compositions of Claims 1, 6, 17 and 21 into the contaminated geologic media for one or more specified periods of time at a specified delivery rate for promoting the growth of indigenous MRP anaerobic microorganisms via the denitrification pathway;

b) performing a second phase of operation by adding one or more of the chemical compositions of Claims 17, 21 and 26 into the contaminated geologic media for one or more specified periods of time at a specified delivery rate for promoting the growth of indigenous MRP anaerobic microorganisms via microbial respiration pathways involving manganese-reduction, iron-reduction and/or the reduction of other metals;

c) performing a third phase of operation involving the addition of the chemical composition of Claim 12 for one or more specified periods of time at a specified delivery rate for promoting the growth of anaerobic bacteria via the sulfate-reduction pathway; and

d) repeating and/or alternating steps a), b), and c) until the level of contaminants in the contaminated geologic media are reduced.

63. The method of Claim 61 whereby the specified number and duration of delivery events of the said chemical compositions promote the log-phase growth of the anaerobic biomass within the

contaminated geologic media.

64. The method of Claim 62 whereby the specified number and duration of delivery events of the said chemical compositions promote the log-phase growth of the anaerobic biomass within the contaminated geologic media.

65. The method of Claim 61 further including the step of introducing into the contaminated geologic media no chemical composition for one or more specified periods of time so as to allow for the decay of the anaerobic biomass within the contaminated geologic media.

66. The method of Claim 62 further including the step of introducing into the contaminated geologic media no chemical composition for one or more specified periods of time so as to allow for the decay of the anaerobic biomass within the contaminated geologic media.

67. The method of Claims 63 to 66 whereby the periods of log-phase growth and decay of the anaerobic biomass are cycled and/or repeated so as to optimize the biodegradation, transformation or detoxification of organic and/or inorganic contaminants by MRP anaerobic microorganisms.

68. The method of Claims 61 and 62, further including the step of introducing into the contaminated geologic media a carbon co-substrate selected from the group consisting of ethanol, methanol, or acetate for one or more specified periods of time at a specified delivery rate for promoting the biodegradation, transformation or detoxification of organic contaminants by MRP anaerobic microorganisms.

69. The method of Claims 61 and 62, further including the step of introducing into the contaminated geologic media a primary carbon substrate selected from the group consisting of ethanol, methanol, or acetate for one or more specified periods of time at a specified delivery rate for promoting the biodegradation, transformation or detoxification of inorganic contaminants by MRP anaerobic microorganisms.

70. Bioremediation apparatus including a vapor suppression system for reducing flash fire and/or explosion hazards in the contaminated geologic media comprising:

a) one or more gas cylinder tanks containing an inert gas for reducing oxygen gas (O_2) concentrations within the contaminated geologic media;

b) control valve means connected to said one or more gas cylinder tanks;

c) pressure sensing means connected to said one or more gas cylinder tanks for providing a minimum pressure setting in which

said inert gas is discharged from said gas cylinder tanks to the contaminated geologic media; and

d) means for connecting a second well to said gas cylinder tanks

for supplying said inert gas to the contaminated geologic media.

71. Bioremediation apparatus in accordance with Claim 70, wherein said inert gas is argon, neon, krypton or xenon.

72. Bioremediation apparatus in accordance with Claim 70, wherein said control valve means is a manual shut-off valve.

73. Bioremediation apparatus in accordance with Claim 70, wherein said pressure sensing means include one or more in-line pressure gauges.

74. A method of suppressing malodorous compounds, comprising the steps of:

a) applying a chemical composition to an area containing malodorous compounds, such as hydrogen sulfide, to provide an electron acceptor compound to reduce the formation of hydrogen sulfide;

b) said chemical composition being selected from the group consisting of the chemical compositions defined above in Claims 1, 6, 17, 21, 26, 48, and 52.